STRUCTURAL ELEMENT REVIEW CHECKLISTS

ELEMENT: Slab Bridge

Description: Bridge whose spans are made up of a slab only (no beams). Supports are included if they are bents (cap on piles). Piers and vertical abutments are separate elements not included here.

Checklist:

a. Have the correct loadings been designed for (ie. variable truck lengths, military loading when applicable, future wearing surface,etc.)?

b. Has the slab thickness been designed for using (S+10)/30?
If not, then the live load deflections must be checked. (AASHTO 8.9)

c. Was the correct cover (and corresponding d value) used?

d. Were the correct concrete and reinforcing steel strengths used?

e. Does the depth of the slab provide great enough moment capacity?

f. Does the reinforcing steel used provide enough moment capacity?

g. Were the correct lap lengths used?

h. Were the correct development lengths used?

i. Were bar cutoff points determined correctly?

j. Was fatigue checked for? (Lee's program gives values for area of steel required for fatigue, but it gives only the largest of the positive and negative values. Thus there are areas where the smaller value could control and these need to be checked for and appropriate adjustments to the reinforcing steel made.)

k. Has the edge beam been correctly designed for? (AASHTO 3.24.8)

l. Has the distribution steel been designed for correctly?
(AASHTO 3.24.10)

m. Has the temperature steel been designed for correctly?
(AASHTO 8.20)

n. Have pile loadings been calculated correctly?

o. Do the pile type and loadings agree with the Geotechnical recommendations?

p. Was the main cap reinforcement (positive and negative moment steel) designed for correctly?

q. Was shear reinforcement in the cap designed for correctly?

ELEMENT: Deck

Description: A slab supported by girders or beams.

Checklist:

a. Is the amount of top and bottom steel provided adequate?
(Main steel, distribution steel, temperature steel and longitudinal steel over interior supports)
(See AASHTO 3.24.10.2 for distribution steel)

b. Are embedment and development lengths adequate (AASHTO 8.24 & AASHTO 8.25)?

c. Are lap lengths adequate? (See Bridge Memo 246 for tension laps and AASHTO 8.32.4 for compression laps.)

d. Sidewalk design

e. For prestressed structures:
Were Group IV moments (includes restraint moments) at the interior supports? (PCBM gives longitudinal slab steel required based on Group I moments. Occasionally Group IV will be larger at the interior supports).

ELEMENT: Prestressed Concrete Beam or Girder

Description: Any concrete beam with prestressing strands (I-beam, box beam, Bulb-Tee, etc.)

Checklist:

a. have proper loadings been designed for [ie. variable truck, military (bridge memo #224), permanent steeel deck forms, etc.]
b. are allowable stresses OK
c. are there enough strands provided (typically check final stresses near midspan)?
d. check initial stresses at bond break points
e. check stresses (both final and initial) due to prestressing at end of beam
f. check compressive stress, bottom of girder (Working Stress) (Bridge Memo #227)
g. check stirrups
h. check number of strands provided versus number of strands required at tenth points (development of strands)
i. check restraint moments (no. of strnds to extend up)
j. Is debonding pattern OK (Bridge Memo #227)?
k. Are there the proper number of diaphragms?
l. If bulb-tee used, have provisions of Bridge Memo #248 been followed?
m. For Illinois I-beams see Bridge Memo #235.
n. has camber been calculated?

ELEMENT: Steel Girder

Checklist:

a. Proper loadings?

b. Allowable stresses for concrete, reinf. steel, and structural steel?

c. Allowable deflection, camber diagram, blocking dimensions

d. Check minimum flange to web thickness.

e. Check INDOT minimum web and flange thickness (minimum flange 12" x 3/4").

f. Check for excessive coping overhang.

g. AISC steel design program?

h. Shear program?

i. BEARING STIFFENER DESIGN

- thickness
- compression in concentrically loaded columns
- check stiffener stress when deducting clipped corners
- check weld size

j. FIELD SPLICE DESIGN

- check locations
- check reduction in flange area due to bolt holes
- web splices
  - get design moment and shears
  - check moment resisted by web
  - check stress in web splice plate
  - check fatigue stress range
  - check web splice bolts (minimum 3 bolts per row)
  - check slip critical joints
  - check slip resistance due to overload

- flange plates
    - design flange plates only for portion of design moment not resisted by web, or 75% maximum capacity of section
    - flange splices must be long enough to develop the allowable strength of the member
    - how many bolts required in the flange
    - check fatigue stress range (AASHTO cycles)
    - check flange to web weld sizes
    - check flange weld sizes

k. SHEAR CONNECTOR DESIGN

- check fatigue
- allowable range of horizontal shear per connector
- required spacing
- check number of connectors required
- determine dead load contraflexure points for termination of shear studs
- check for additional connectors to develop slab stresses

l. LATERAL BRACING

- check need for lateral bracing for compression flange
- if needed, determine spacing
- check for need of lateral wind bracing

m. CROSS FRAMES

- check horizontal force in cross frames
- standard INDOT cross frames should work, review those details

n. TRANSVERSE INTERMEDIATE STIFFENERS

- check shear
- check to see if stiffeners are needed for web sizes
- determine shear capacity of girder with a stiffened web
- design spacing
- design size

- determine where stiffeners may be omitted, compare weight of stiffeners to weight of heavier web
- see INDOT intermediate stiffener detail
- check tension in reversal area

o. LONGITUDINAL STIFFENERS

- are they needed?

p. CHECK ALLOWABLE FATIGUE STRESS OF TOP AND BOTTOM FLANGES

q. JACKING FRAME DESIGN

- web size
- flange size
- spacing
- check section modulus
- check connections
- check bearing stiffeners for jacking frame
- allowable bearing stress
- check compression stress in concentrically loaded columns

ELEMENT: Bearing Assembly

Checklist:

a. check reaction loads

b. check for uplift (may need tie down devices)

c. determine loads for assembly design

d. design assembly (plates, elastomeric pads, etc.)

ELEMENT: Piers

Description: Interior support typically including a cap, stem (column), and footing

Checklist:

General

a. Have the proper allowable concrete stesses been used?

Footings

a. Have the proper loadings been designed for?

b. Has the bottom of footing elevation been set properly?

c. Have pile loadings (or footing pressure for spread footings) been calculated properly?

d. Has uplift been checked?

e. Is the pile/footing design consistent with the geotechnical recommendations? (ie. pile type, tip elevs., scour elev., etc.)

f. Has shear and two-way action been checked in the footing? (The depth of the footing should be large enough that no reinforcement is required for these items.)

g. Has the footing moment steel been designed properly?

Cap/Cantilever

a. Has the top longitudinal cap steel been designed correctly?

b. Has the concrete stress in the cap been checked?

c. Has the shear reinforcement in the cantilever been designed correctly?

Column

a. Was the proper K factor used?

b. Has the vertical column steel been designed correctly?

c. Has the proper amount of temperature steel been provided?

ELEMENT: End Bents

Description: End support with a cap on piles.

Checklist:

Integral

a. Have pile loadings been correctly calculated?

b. Is the pile design consistent with the geotechnical recommendations? (ie. pile type, tip elevs., etc.) Are pile wall thicknesses/pile size OK?

c. Does the reinforcing steel match the criteria outlined in Bridge Memo #233?

d. Is the rest of Br. Memo #233 complied with?

Conventional

a. Have pile loadings been correctly calculated?

b. Is the pile design consistent with geotechnical recommendations? Are pile wall thicknesses/pile size OK?

c. Joints?

d. Has the positive and negative moment steel been designed correctly?

e. Are lap lengths sufficient? (See Bridge Memo 246 for tension laps and AASHTO 8.32.4 for compression laps.)

ELEMENT:VERTICAL ABUTMENTS

CHECKLIST:

General

a. Have the proper allowable concrete stresses been used?
b. Has the structure been correctly designed for seismic considerations?
c. Are the proper beam reactions being used?

Footings/stem

a. Has the bottom of footing elevation been set properly?
b. Have all the overturning forces been properly calculated?
c. Have AASHTO group loadings been looked at?
d. Have the pile loads been calculated properly?
e. Are the number of piles correct? Battered piles? Are the pile spacings within the maximum and minumum allowed?
f. Have the pile lengths been calculated from the estimated pile elevations as set in the soils report?
g. Is the depth of footing thick enough such that no shear reinforcement is required?
h. If no piles, is a shear key necessary?
i. Check earth pressures & settlement from soils report.
j. Has stem steel been calculated properly?
k. Is temperature steel provided?
l. Has footing moment steel been calculated properly?
m. Has the proper pile size and thickness been used?
n. Have weep holes or drains been utilized?
o. Check for uplift, no uplift is allowed.
p. Is the rear face at a 1h to 12v?
q. Has the wingwall been designed properly?